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Two-Dimensional Halide Perovskite Nanowires

Low-cost, tuneable perovskite nanowires with long carrier lifetimes for waveguides, lasing, and integrated photonics.

Researchers at Purdue University have discovered a method for synthesizing 1D nanowires from traditionally 2D perovskite materials. Standard inorganic semiconductor nanowires have exceptional electronic properties but result in high fabrication costs and elevated processing temperatures. Alternatives such as organic semiconductor nanowires offer cost-effective solution processability. However, organic derivatives are limited by inferior charge carrier mobility and are subject to aggregation-induced luminescence quenching and high optical loss.

The Purdue researchers' method helps the semiconductor industry fabricate low-cost and high-performance perovskite nanowires with tunable organic-inorganic chemical compositions and large aspect ratios. The 1D nanowires produced from 2D perovskites are exceptional candidates for active waveguides because of their editable length, emission tunability, and bendable morphology. The method promotes metal halide perovskites with excellent carrier lifetime and high optical absorption coefficient. This method satisfies the strong demand for harnessing organic-inorganic hybrid semiconductors for next-generation nanowire photonics and electronics.

Technology Validation:

The synthesized nanowires were examined through tip-tip interactions or cross-intersections, demonstrating proof-of-concept potentials to construct more intricate optical networks. The nanowires displayed exceptional cavity quality, fostering active waveguides with low loss coefficients. The nanowires also displayed potential for lasing, with a lasing threshold of 16.96 uJ/cm^2 pump fluence.

Advantages:

-Improved nanowire carrier lifetime and diffusion length

Technology ID

2024-DOU-70422

Category

Chemicals & Advanced Materials/Specialty & Performance Chemicals

Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

Further information

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-Low-cost and high-quality

-Efficient and unique emission tunability

Applications:

-Semiconductor industry

-Organic-inorganic hybrid semiconductors

-Nanowire photonics and electronics

-LiDAR

Related Publications:

Wenhao Shao et al. ,Molecular templating of layered halide perovskite nanowires.Science384,1000-1006(2024).DOI:10.1126/science.adl0920

https://www.purdue.edu/newsroom/releases/2024/Q2/purdue-researchers-crystal-engineering-modifies-2d-metal-halide-perovskites-into-1d-nanowires.html

TRL: 6

Intellectual Property:

Provisional-Gov. Funding, 2023-10-10, United States

Utility-Gov. Funding, 2024-10-09, United States

Keywords: AI, Artificial Intelligence, autonomous defect detection, autonomy, Civil Engineering, Computer Technology, Computer Vision, damage assessment, Infrastructure, Machine Learning, Robotic inspection, structural